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AGRICULTURAL Research

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Food for Wildlife

Wildlife, indeed all life, owes its existence to vegetation. Even the dependence of predators is but one or two steps removed. With some exceptions, our wildlife still endures—several species even flourish because we have been changing the face of this country since colonial days. Land formerly in forests soon grows a richly diverse store of food plants which offset changes to habitat. Moreover, many species that once lived entirely on wild native plants now share our farm crops and their accompanying residues and weeds.

USDA's plant introduction system, established in 1898, has supplied a wealth of food for wildlife. Every year thousands of new plant materials from abroad arrive at the Agricultural Research Center, collected by ARS plant explorers or sent in by foreign scientists, businessmen, missionaries, and private citizens. ARS scientists screen, catalog, and distribute these items to regional introduction stations for propagation and trial. State and Federal conservation agency tests show that these "immigrants" often make excellent wildlife foods.

Ducks, for example, feast in the dense stands of millets planted in many of our wildlife refuges. Across the South, a common duck food is Japanese millet, introduced from India. Elsewhere, ducks are taking to browntop millet. Its seeds, uniquely, do not rot after falling into the water, thus providing food for diving ducks well into autumn.

Quail frequent thickets of lespedeza bicolor, planted from Pennsylvania southward. This dual-purpose plant from eastern Asia offers both food and cover. In the South quail feed on dove proso, a millet from India that also attracts ducks.

Turkeys and squirrels depend on nuts and acorns. The sawtooth oak from China appears to produce much heavier and more dependable crops of acorns than the native southeastern oaks. It begins bearing when 6 years old, about 14 years earlier than native trees. Another heavy producer under test is the Chinese chestnut. It seems adapted to open areas rather than woods.

Providing food and cover is a vital step in preserving our wildlife and maintaining outdoor places where we can kindle an ancient bond with nature.

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Clifford M. Hardin, Secretary
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a breakthrough . . .

mycoplasma isolated from plants

Stevens, Hampton, and Allen examine Bell bean plants that have been mechanically infected with mycoplasma (PN–1824).

A MYCOPLASMA, a type of microorganism associated with diseases of animals, has for the first time been identified as the cause of a mechanically transmitted plant disease.

This major breakthrough, which may provide vital data needed in controlling many diseases in plants, came in cooperative studies by ARS plant pathologist R. O. Hampton, and by veterinary medical researcher J. O. Stevens and plant pathologist T. C. Allen of the Oregon Agricultural Experiment Station, Corvallis.

Mycoplasmas are the smallest free-

living organisms now known. They are intermediate between bacteria and viruses in size and are generally spheroid but appear in other shapes. Mycoplasmas differ from bacteria in that they have an external membrane rather than a cell wall.

In 1967, Japanese scientists observed mycoplasma-like structures in conductive tissues of plants affected by aster yellows but were unable to isolate and identify the disease agent as mycoplasma.

The American researchers made their discovery while studying peas naturally infected with alfalfa mosaic virus (AMV). Hampton, while attempting to characterize an unusual isolate of the virus in a partially purified preparation of AMV, observed some unfamiliar membranous structures similar to those described for animal mycoplasmas. By electron microscopy he also found comparable structures in the cells of infected plants. He then developed the techniques necessary to isolate, purify, and to characterize the mycoplasma.

Methods and growth media for artificially propagating the new microorganism were developed by Stevens, who with Hampton also established its close relationship to three mycoplasmas infectious to animals.

Allen developed new electron microscopic techniques for characterizing the plant mycoplasma, as well as certain animal mycoplasmas.

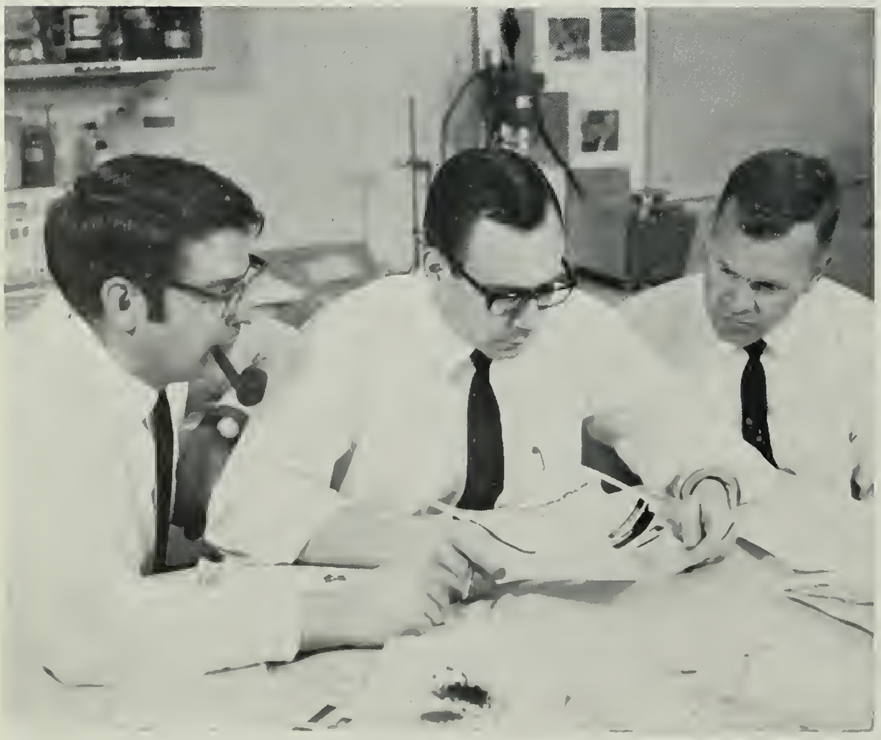
The team purified and serologically identified the plant mycoplasma and cultured it in an artificial, serum-rich liquid medium. In experiments to determine the mycoplasma's potential to infect, they found that pea plants inoculated with purified mycoplasma free of AMV produced only mild disease symptoms—a faint chlorotic mottle. But when the purified mycoplasma was combined with purified AMV and introduced into the test plants, the original disease symptoms were produced.

The researchers produced an antiserum to purified plant mycoplasma and tested it serologically against 20 animal and human mycoplasma species or serotypes. Mycoplasma from peas proved closely related to *Mycoplasma gallisepticum*, which causes chronic respiratory disease in chickens and to *M. meleagridis*, a cause of airsacculitis in turkeys.

They transmitted the combined mycoplasma-AMV complex to peas, Bell beans, and cowpeas. The two agents remained together after 20 sequential mechanical transmissions in peas, indicating that there is no tendency to eliminate either agent during routine inoculations.

Practical controls for mycoplasma-caused plant diseases have not yet been developed. However, researchers in Japan and our country have suppressed symptoms of plants infected with aster yellows and related diseases by applying tetracycline antibiotics. The U.S. scientists point out that mycoplasmas associated with animal diseases also are susceptible to the tetracyclines. ■

Left: *Allen, Stevens, and Hampton examine electron photomicrographs of purified mycoplasma and thin-sectioned plant tissue infected with mycoplasma (PN–1826).* ***Right:*** *Stevens records positive and negative reactions between mycoplasmas and selected antisera (PN–1825).*



alfalfas that curb pea aphids

PEA APHIDS cost alfalfa growers in the United States about $42 million a year in crop damage alone—a loss that new resistant alfalfa varieties should sharply reduce.

Since 1966, three pea aphid-resistant varieties, developed in cooperative research by ARS and State agricultural experiment stations, have already been released. The first was Washoe, developed by ARS and Nevada and made available in the spring of 1966 for the irrigated areas of the Pacific Coast and Intermountain Region. Dawson was released in 1967 by ARS and Nebraska for the North Central States. Last spring, Kanza was released by ARS and the Kansas, Nebraska, and Oklahoma stations for the South Central States.

Field trials of Kanza conducted in Kansas during 1968 showed the value of aphid resistance. The aphids are most abundant and cause the most damage in Kansas during April and May. Damage ranges from stunting and yellowing of plants to death of the entire top growth. Seedlings, especially spring seedlings, are most vulnerable to aphid attack. Throughout the State, aphid damage to alfalfa that year was estimated at more than $9 million.

In trials at Mound Valley, Hutchinson, and Belleville, Kans., however, the first-cut forage yields of Kanza were 220 percent higher than the susceptible variety, Buffalo. At Manhattan, where the aphid infestation was heavy but the top growth of susceptible varieties was not killed, the first-cut yield of Kanza was 2.29 tons per acre compared to 1.27 tons of Cody, the susceptible variety.

Protein yields of Kanza were almost double, and carotene yields about triple those of the Buffalo, Ranger, and Vernal varieties.

At other Kansas locations, where the aphid populations varied, four to six times as many aphids were on Buffalo as on Kanza. At Manhattan the aphids per gram of dry matter in Buffalo outnumbered those in Kanza by nine to one. During the study, Kanza was 13 inches tall at the peak of aphid infestation, compared to 7 inches for Buffalo, Lahontan, Ranger, and Vernal.

At Hays, following a heavy aphid infestation in April, the resistant plants out-yielded susceptible plants more than two to one on all subsequent crops including the fourth cutting in September 1968.

When alfalfa growth is retarded, weeds take over and severely compete with alfalfa for nutrients and water. In addition, when pea aphids damage the first cutting, the plants may be so weakened that forage yields from later cuttings are reduced.

Switching to the new varieties does pay large dividends, say the researchers. Resistant alfalfa varieties provide significant protection against aphid damage with no extra costs in either material or labor. And, just as important, there is no danger from chemicals or their residues since no pesticides are needed to control the insect. ■

Spotted alfalfa aphids on right have six or more rows of dark spots on back compared with spotless back of pea aphids. Both species give birth to living young (PN–1827).

the knowing hand

NEARLY EVERY TIME a consumer selects a suit, a dress, or material for drapes or slip covers, his hand plays an important role, although he may not be aware of it.

Fingers fondle the fabric; tips skim the surface. Perhaps the fabric is crunched in a firm grip. The feel of the fabric makes an impression, either favorable or unfavorable, that helps the consumer make his decision. "Hand" is an expression textile people use to summarize these sensations, and many terms are used to define hand, numbering perhaps in the hundreds. Some of the most common are soft, crisp, firm, hard, harsh, boardy, dead, lively, wiry, cold, warm, and dry.

The role of the hand in buying is today essentially the same as it has been for centuries, but in manufacturing there have been recent major changes. Scientific and technological advances have given fabric makers the capability to impart into fabrics almost precisely the feel most pleasing to consumers—if they had a sure way of getting consumers' "final word" on what is desired.

A method to determine this final word, and feed it back to fabric makers, is being developed by ARS textile chemist H. P. Lundgren at the Western utilization research laboratory, Albany, Calif.

Lundgren's approach is to:

• Regard finished fabric as a communication channel containing information encoded by the manufacturer, and the human hand as a receptor that can pick up the encoded information. Specific sensory centers are present in the hand which are uniquely sensitive to roughness, stiffness, compactness and to heat and cold. These centers are considered to react in "on/off" fashion, like digital computers, to encoded plus and minus stimuli in a fabric.

• Apply ideas from modern concepts of information theory, decision theory, and computer analysis to convert information picked up by the hand to mathematical measurements of a fabric's acceptance by consumers for a specified use.

• Report findings to the fabric manufacturer so he can make modifications and adjustments as needed to create the fabric hand most appealing to consumers.

Lundgren has suggested a mathematical model in which the hand of the fabric is expressed in terms of the four basic elements of texture. These four elements, arrived at by means of factor analysis techniques by W. S. Howorth in England, are roughness, stiffness, compactness, and thermal character.

Since Lundgren's system requires participating panelists to rate on a plus and minus scale, rather than a simple graduation such as 1 to 5, the terms he uses to describe the four fabric elements are in plus or minus pairs. They are roughness-smoothness, stiffness-flexibility, heaviness-lightness, and coldness-warmth. Levels on the rating scale range from +3 (extremely acceptable for the specified use) to −3 (extremely unacceptable).

After panelists have rated fabrics on these four pairs of elements, the ratings are weighed and corrected in formulas Lundgren has developed to express, in mathematical terms, the human judgment of fabric hand for a specified end use.

Final information processing is by computer. ■

mechanizing the harvest . . . CITRUS PICK-UP SERVICE

How to harvest the 8-million-ton Florida citrus crop in the face of spiraling labor costs is a challenge for agricultural engineers. But they are finding some answers.

In one harvest system being researched, the fruit is shaken to the ground, windrowed, picked up, and transferred to a "high-lift" grove truck. The first two parts of the system—tree shaker and windrow equipment—are presently in experimental use. The third part, a pick-up machine, is under study by ARS agricultural engineers D. E. Marshall and S. L. Hedden at the University of Florida Citrus Experiment Station, Lake Alfred. The machine picks up citrus fruit from a windrow and removes most of the trash—with minimum damage to the fruit.

Although fruit destined for the canning plant is processed within 48 hours, the citrus coming from the pick-up machine was deliberately held 3 days to evaluate decay. The fruit showed an average of 3.7 percent decay (stem end rot and *Penicillium* mold), not excessive for the Parson Brown oranges being harvested. Physical damage was also checked as the fruit was unloaded into a grove truck. An average of 4 percent was punctured, 3 percent split, and 2 percent badly bruised.

In operation, as the machine travels down a windrow of citrus, huge spiral brushes roll the fruit to the center of the machine. A digger blade, set at 1 to 2 inches below ground level, knifes under the fruit, directing it first to a pick-up conveyor chain, then to an elevator belt. The elevator belt directs the fruit and trash higher into the machine where it drops onto the trash eliminator belt moving across the machine and out the side.

Fruit bounces or rolls off the trash belt onto a clean-fruit conveyor belt below, is picked up by a bucket elevator, and deposited in a holding bin above and in back of the machine. An unloading conveyor then transfers the fruit from the bin to the high-lift truck at a rate of 4,000 pounds per minute.

Average pick-up rate of all trials was 408 pounds per minute with a maximum rate of 600 pounds per minute. This was well matched with the windrowing and hauling system.

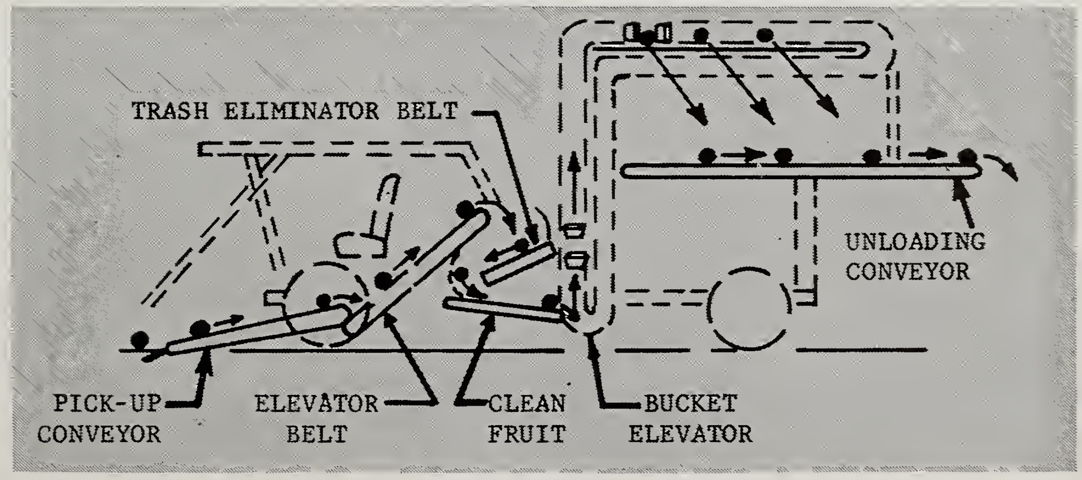
The trash eliminator belt worked effectively under most conditions. Fruit bounced or rolled off the belt while leaves, weeds, bottles, sticks, and sand that had not fallen through the pick-up conveyor chain were carried off by a rough-top belt. A roll angle of 15°, a pitch angle of 30°, and a belt speed of 150 feet per minute gave the best results. More study is needed, the engineers say, to improve the machine for high-trash conditions.

Average pick-up speed of the machine is about 23 feet per minute, but speeds up to 16 miles per hour are possible when moving the machine from field to field on the highway. The machine operates well in groves with loose sandy soils.

The engineers say that the pick-up machine can keep up with six tree shakers—with an overall field efficiency of 75 percent when unloading time, down time, and turn around time are considered.

The Florida Agricultural Experiment Station is cooperating in the study of harvesting systems. ■

Left: Close-up of citrus entering pick-up machine. Note fruit in holding bin above and back of operator (PN–1828). Right: Trash is dropped off trash eliminator belt after fruit has bounced onto clean fruit conveyor belt (PN–1829).



Cover: Port inspector Maynard Kurtz watches as a race horse is led onto an unloading ramp that was taxied up to plane at Animal Import-Export Quarantine Station, Miami, Fla. This procedure prevents horse from touching and possibly contaminating ground. Threat is real—horses sometimes race in Europe one day, then at a U.S. track 48 hours later (ST–4284–6). ***Right:*** *Animal handler picks and cleans hoofs, removing extraneous materials that might introduce disease organisms (ST–4312–5).*

OPERATION SAFEGUARD

A WAVE OF foot-and-mouth disease outbreaks swept through Great Britain in 1967. Before officials halted the epidemic, it was necessary to slaughter and dispose of more than 420,000 animals.

Although reservoirs of FMD exist in all but a few major livestock-producing countries, the United States has not had an outbreak of this disease during the last 40 years.

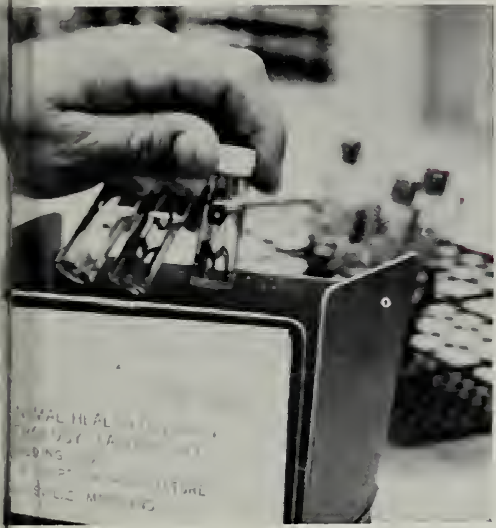
Our line of defense against FMD—and other epidemic diseases—is manned by ARS veterinarians and inspectors stationed at border, ocean and air ports. Their job is to protect our $26 billion livestock industry while permitting, as far as is possible, a free flow of international trade in livestock. In the jet age this is no easy task. For not only are most imported animals that enter ocean or air ports flown in, but the travel time of aircraft usually outpaces the incubation period of a disease.

To keep out foreign diseases, animal health inspectors rely on a system involving prior permits (these vary depending on species and disease conditions in country of origin), certificates of health from exporting country, and inspection and quarantine at U.S. ports of entry. When required, quarantine periods are always imposed on a scientific basis according to the species of animal, where it comes from, and type of tests or treatment necessary. At all times, the officials must assure the animals' humane handling, comfort, and safety.

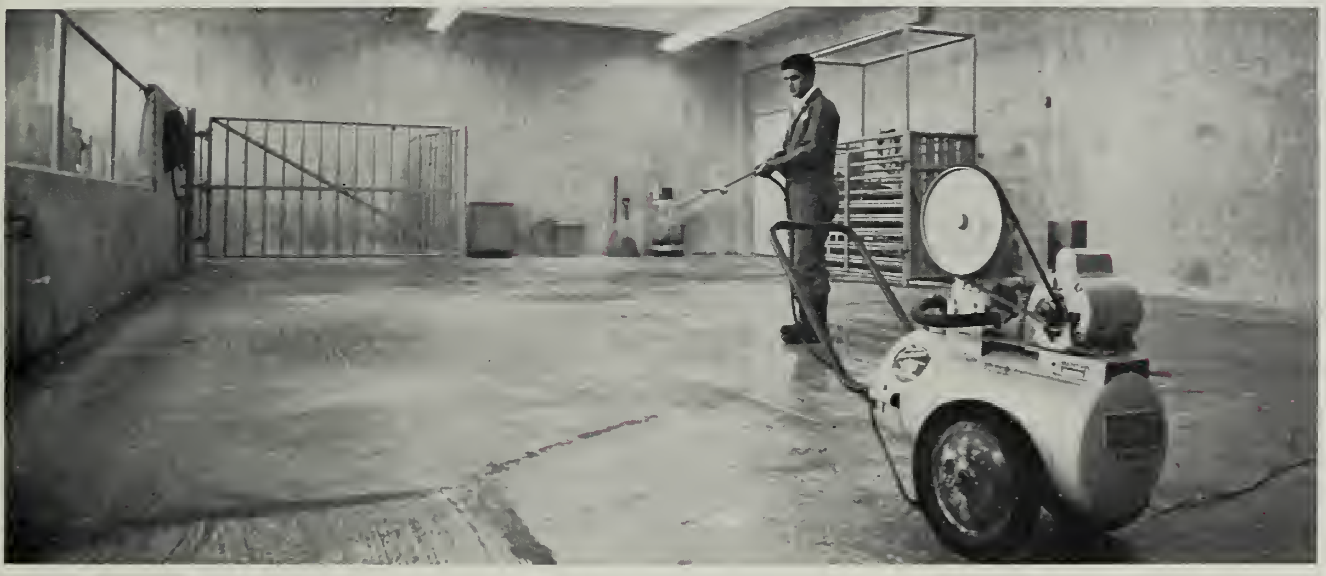
Animals are imported for various reasons such as breeding, racing, scientific study, or exhibition. Those consigned to zoos present special problems since many come from regions where FMD and rinderpest exist. Thus certain wild animals susceptible to those diseases may enter only through the Port of New York via ARS' facility in Clifton, N.J. Once released, they are under permanent ARS quarantine supervision at approved zoos.

ARS animal health specialists also inspect and certify livestock for export. To promote our export trade, Congress requires that only healthy animals be exported in the hope that they will reach buyers in good condition. Over the years, governments abroad have come to depend on our export regulations and the integrity of their enforcement.

As the international trade in animals continues to mount, our inspection and quarantine operation must grow in scope and complexity. Success requires constant vigilance—the cost of failure is too high. ■



Left: Veterinarian places serum samples drawn from horses in special container for air shipment to Beltsville and laboratory tests for dourine and glanders. Horses remain in quarantine pending outcome of tests. Both diseases—which also affect people—have been eradicated from the United States (BN–34852). ***Right:*** *Cattle undergo visual inspection in small groups. The "attitude" of an animal frequently indicates its general health. Animals that require closer inspection are cut out and examined individually in squeeze chute (ST–4296–19).*



Left: *Attendant promptly cleans and disinfects receiving area after animals leave for quarantine quarters. Stall in background is used to examine each animal, then spray it for possible external parasites (ST–4297–4).*

Left: *Breeding cattle destined for a ranch in Venezuela board the M.S. Clara Clausen at Tampa Port Authority facility, Tampa, Fla. The same stringent health safeguards apply to export as well as import animals. Animal health official also makes certain that requirements for humane handling are met and followed regardless of mode of transport (ST–4315–12).*

Below: *Veterinarian W. H. Wilson's signature on USDA Certificate of Inspection attests that animals are clean, healthy, and free of communicable disease, permitting ship to leave with its cargo of cattle (BN–33990).*

EVIDENCE that the African swine fever virus contains deoxyribonucleic acid is an important step toward understanding a disease that baffles scientists and imperils livestock.

Most viruses contain either deoxyribonucleic acid (DNA) or ribonucleic acid (RNA). ARS scientists at the Plum Island Animal Disease Laboratory, Greenport, N.Y., have shown in three related experiments that African swine fever virus (ASFV) is in the DNA group of viruses.

In its most virulent form, ASFV kills pigs in 4 days or more by damaging the walls of the small blood vessels. All pigs of domestic breeds are susceptible. Wild warthogs in sub-Sahara Africa, however, seem to live in perfect harmony with the virus. Apparently the infection is passed among the warthogs without outward indications.

Strict animal disease quarantine inspection has excluded ASFV from the United States. However, the disease raised havoc in the swine industry of Spain and Italy 2 years ago and caused severe economic losses in Portugal in 1957. The fact that the disease may develop so gradually as to become well established before it can be diagnosed confounded the Italian diagnosticians in 1967.

Body response to ASFV is also unusual in that protective antibodies have not been found in pigs that survive the disease. Survivors nevertheless harbor the virus and become a source for perpetuating the disease. These characteristics of ASFV discourage progress toward eradication or development of a successful vaccine, which depends upon artificial stimulation of protective antibodies.

ARS scientists A. H. Dardiri, W. R. Hess, C. J. DeBoer, and S. S. Breese are attempting to decipher the structure of ASFV by physical and chemical means to gain an insight into its mysterious behavior. Their research is done in complete isolation on an uninhabited island in Long Island Sound.

The first step was determining whether the virus contains DNA or RNA.

In one experiment, they prepared ultrathin sections of infected tissue culture cells in a substance that would allow chemical reactions to take place. Then they treated the virus-infected cells with enzymes—pepsin, that would remove the outer protein coats; DNase, that would remove DNA; or RNase, that would remove RNA.

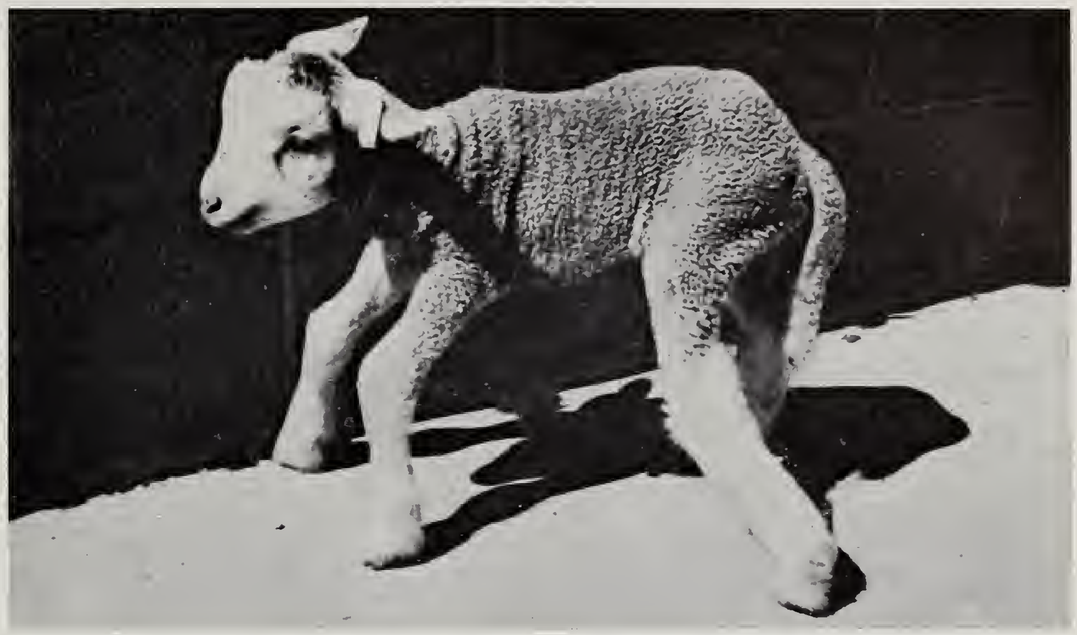
Electron micrographs of the treated sections showed that pepsin removed the outer protein coats and left the cores intact. DNase removed the cores, leaving the outer shell intact, while RNase gave no response. The scientists therefore concluded that ASFV is a DNA virus.

This finding was confirmed in subsequent experiments. When the DNA core was freed of the protecting coats, they found that the virus retains infectivity and may initiate reproduction of a complete virus particle when brought in contact with cells in cultures washed free of DNase.

Further studies showed it is possible to produce coreless, noninfective virus by treating infected tissue culture cells with the chemical hydroxyurea, which suppresses the formation of viral DNA. Electron microscopy showed that particles without cores were released from the treated cells, and biological tests indicated that they reacted only as protein shells. ■

DNA VIRUS causes african swine fever

ARS veterinarian W. R. Hess draws blood sample for diagnosis. Test showed this hog reacted positively following exposure to experimental culture (PN–1830).



Cyclopamine, a chemical found in some plants of the Veratrum *species in the lily family, was fed to pregnant ewe and caused looseness of knees and hock joints in her lamb (PN–1451).*

Plants that cause BIRTH DEFECTS

Birth defects in animals were once laid to bad genetics. But since 1960, ARS scientists have been showing that they are also caused by seemingly innocuous plants the mother eats during pregnancy.

And these animal studies help explain certain human birth defects.

So thinks ARS veterinarian Wayne Binns, director of the Poisonous Plant Laboratory, Logan, Utah. The relationship between the mother's food intake and fetal development is not absolute, however—results depend on the type of chemical involved, the environment, and the stage of pregnancy.

One of the most revealing animal defects meaningful to human medicine is cyclopamine poisoning. In fact, cyclopamine effect on fetal lambs was the first medical case in which the cause of a major birth defect in mammals was discovered.

Investigations by Binns' staff showed that cyclopamine is carried in false hellebore (*Veratrum californicum*). Although large amounts of false hellebore can stagger or kill a ewe, smaller amounts cause no obvious symptoms in the ewe.

The birth defects that result have some startling resemblances to the infamous side-effects from the tranquilizer thalidomide on human babies. When ewes eat false hellebore on the 14th day of pregnancy, their lambs are born with a cyclops eye (one eye in the center of the head). If ewes eat the weed later in gestation, lambs get leg deformities.

The most productive portion of the cyclopamine studies concerns the effect of ewes grazing on false hellebore on the 14th day of pregnancy. During a short period—perhaps only 6 hours during that day—the worst deformities occur, including cyclops eye and monkey face. The time of poisoning is so crucial that Binns' group finds that in twin lambs one is born normal, the other severely deformed. One fetus apparently develops at a different rate than the other, so that the deformed lamb is exposed to the poison in the ewe's system during the critical stage.

Another case of birth defects discovered in farm animals concerns cows grazing beanweed, also called lupine. Crooked calf disease—the deformity which results—had also been laid originally to bad genes or to nutritional deficiencies. Yet the ARS scientists showed that certain species of lupine are the cause.

Comparisons of cows fed lupine during various stages of early pregnancy show that the worst time for grazing on contaminated ranges is between the 40th and 70th day. Calves born to these cows have twisted and malaligned leg bones, twisted backs or necks, or cleft palates. Slight to moderate malformations result, trials indicate, even when cows eat lupine after the most critical time.

Locoweed, or *Astralagus,* causes skeletal deformities in lambs and calves similar to the defects brought on by lupine. Many young, though not deformed, are small and weak at birth.

Current research suggests that other plants may cause abortion or malformation of the developing fetus. Lathyrus plants, certain species of peas, are being investigated just now, with double significance for man, since in the Middle East, humans as well as animals eat this plant. Also, certain drugs, such as aminopterin, are under study for birth defects caused in man and animals. This drug, a vitamin-B inhibitor, is used to treat leukemia.

ARS scientists working with Binns on poisonous plant problems are livestock specialist L. F. James, physiologist A. E. Johnson, chemist R. F. Keeler, and veterinarian K. R. Van Kampen. They think that discoveries of birth defects linked to natural foods may well be important landmarks in the ultimate prevention of much suffering and hardship in both man and animals. ■

TEAMING two widely used herbicides to get the best performance from each may prove an effective new technique for cotton growers in the western irrigated Cotton Belt.

Experiments by ARS agronomist H. F. Arle at the Cotton Research Center, Phoenix, Ariz., show that the herbicides trifluralin and diuron are safe, less costly, and more effective when combined and applied together than either is alone.

Trifluralin (a,a,a-trifluoro-2, 6-dinitro-N,N-dipropyl-p-toluidine) is used primarily to control annual grasses. It is applied as a preplant, soil-incorporated treatment. However, the compound temporarily retards the top growth of young cotton plants apparently by inhibiting the development of branch roots in the zone where the compound is incorporated. The tap roots grow normally through the same zone, and branch roots develop readily immediately below it. Once these branch roots develop, the cotton plants then recover their vigor and grow normally.

Diuron (3-[3,4-dichlorophenyl]-1,1-dimethylurea), used to control broadleaf weeds, is applied as a basally directed spray after the cotton seedlings have emerged and are at least 6 inches tall. But by this time many weeds are also well established and escape the effects of the chemical, which is designed to control young, actively growing weeds less than 3 inches tall.

If diuron is used as an incorporated-preplant treatment, the weeds are controlled but the young cotton seedlings are injured or killed, too, because root systems in the zone of diuron-treated soil take up the herbicide.

Arle combined the two compounds in a tank, then applied the mixture in liquid form to the test soil composed of equal parts of sand, silt, and clay. The mixture was incorporated 2 inches deep with a 13-foot offset disk. After disking and pre-irrigating, the seed was planted.

As the cotton seedlings developed, the trifluralin inhibited the development of branch roots in the treated zone. The absence of those roots prevented the cotton seedling from taking up diuron, which would injure them. Thus, both broadleaf and grassy weeds were controlled with no damage to the seedlings. And despite the temporary retarding effect of the trifluralin on plant vigor, the lack of weed competition allowed improved yields.

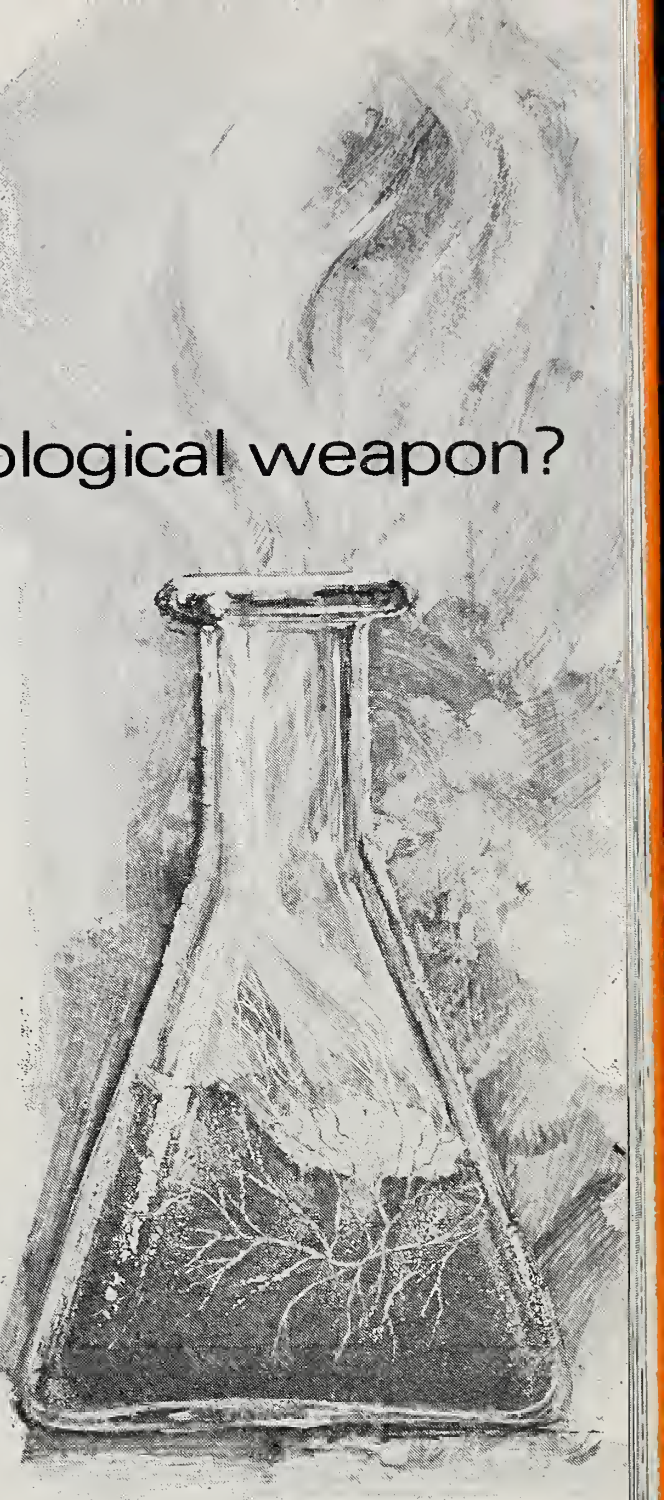
Other advantages accompany yield gains. For example, fewer applications are needed, resulting in a savings in manpower expenditures. Less chemicals are used, thus saving money and reducing the danger from undesirable residues. The combination of these two herbicides in a tank mix for simultaneous application is still in the experimental phase, however, and has not been registered by USDA for weed control in cotton.

In future experiments, Arle will broaden the scope of his tests to include other pesticide combinations to achieve the best possible weed control with safer, less expensive, and more effective techniques. ■

Teamed herbicides for cottons

Cotton plants on left were treated with mixture of trifluralin and diuron, incorporated 4 inches deep. Lateral roots, absent in the incorporation zone, develop below zone and enable plant to overcome initial retardation. Untreated check plant on right (PN–1831).

alfalfa vapors/another biological weapon?



VAPORS from fresh or rotting alfalfa residues stimulate the growth of soil micro-organisms, a finding that may put biological control of plant disease agents into the hands of farmers.

The researchers think the vapors could be employed, for instance, to stimulate dormant plant disease agents (pathogens) to germinate and die out before a susceptible crop is planted.

The research on alfalfa vapors began when ARS microbiologists R. G. Gilbert and J. D. Menzies observed that gases from alfalfa stimulated soil microflora across a 2-inch air space. Fungi grew profusely over the soil surface, bacterial populations increased, and soil respiration was greatly stimulated.

Further, the scientists found that the active compounds could be extracted from several different plants by stem distillation. Of equal importance, studies showed that soils responded to the vapor of aqueous distillates in the same way as to the alfalfa residue.

Microbiologists J. D. Owens, Gilbert, and Menzies at the U.S. Soils Laboratory, Beltsville, Md., isolated and identified the gaseous compounds that are active in various degrees. They found that of some 20 or more volatile components, acetaldehyde was the principal active ingredient, increasing numbers of certain soil fungi and accounting for more than half the soil respiration rate.

Methanol, another component, had little effect on fungal growth but greatly increased the numbers of bacteria. Together, methanol and acetaldehyde had a synergistic effect in increasing the numbers of bacteria.

These findings help explain the erratic results reported by other scientists in experiments to control plant disease agents by adding crop residues to the soils.

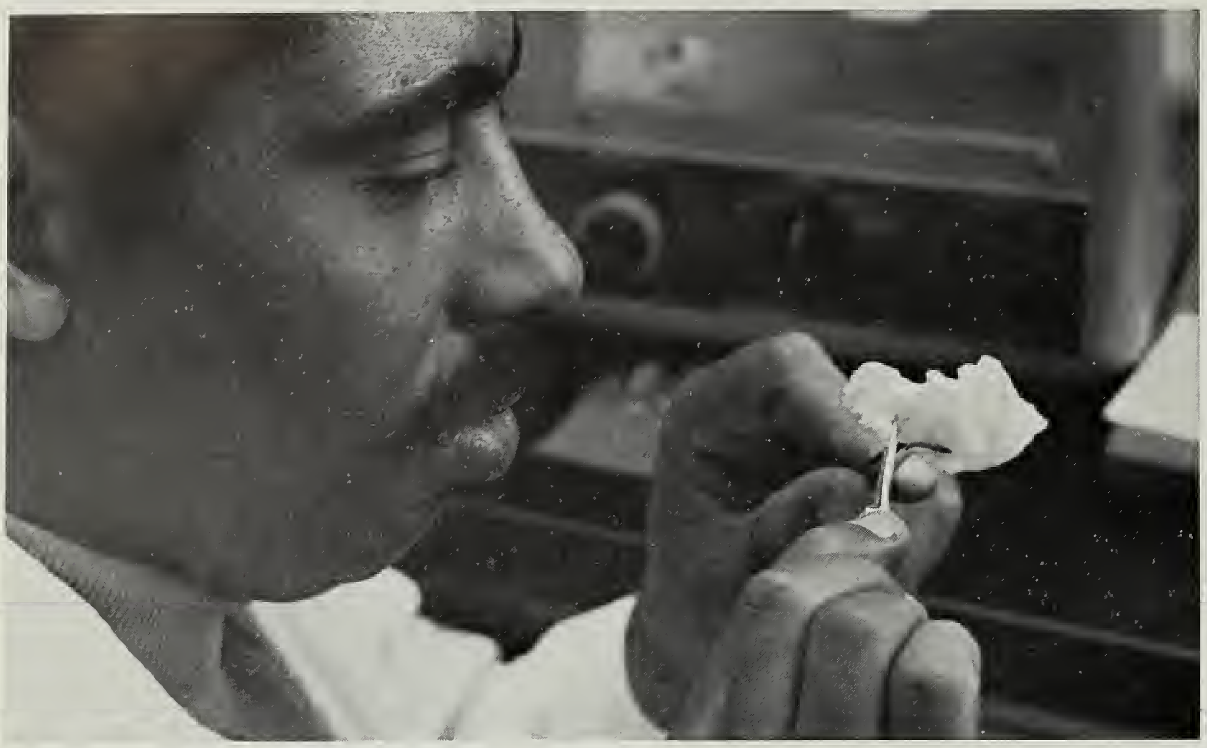
The scientists suggest several possibilities for utilizing the vapors if the compounds can be synthesized on a large scale. The soils could be treated with the compounds not only to germinate pathogens—in the absence of a host crop—but also to stimulate the pathogens in order to render pesticide applications more effective.

Along the same line, the volatiles may be able to stimulate those bacteria that stop or inhibit the growth of certain pathogens. Pathogens are weak and do not compete well with the bulk of soil microflora. These methods would not rid soils of the pathogens, but would give a net decrease in pathogen numbers—lowering the expected incidence of disease.

The scientists also suggest that the volatiles could serve to stimulate bacteria selectively—thus activating those bacteria, for example, that break down DDT and other pesticides.

The scientists found that in addition to acetaldehyde and methanol, the other stimulatory compounds present in alfalfa are isobutyeraldehyde, isovaleraldehyde, 2-methylbutanal and valderaldehyde, and ethanol.

The role of the volatiles in the ecology of soilborne pathogens and root diseases remains to be defined, and much study will be necessary before volatiles are ready to serve the farmer. ■



*Left: Chemist Eugene Wiley weighs and encapsulates collagenous protein isolated from intramuscular tissue (ST–5440–24). **Right:** McClain places encapsulated protein into the differential scanning calorimeter for structural studies (ST–5440–33).*

MEDICAL RESEARCH BENEFITS:

Connective tissue no longer 'inaccessible'

CONNECTIVE TISSUE important in medical and biochemical research but difficult to isolate can now be obtained through a simple procedure.

The new process devised by ARS chemist P. E. McClain, will make possible detailed studies relating to nutritional status, physical vigor, aging, and certain diseases.

Intramuscular connective tissue is composed primarily of proteins called collagen. Collagenous proteins are also the chief constitutents of cartilage, tendon, bone, and skin. To study these proteins, scientists have used tissues from calf and rat skin, rat tail tendons, fish skin, and fish air bladder, the balloon-like sac which keeps the fish afloat. However, it is not known for certain that the collagen from these sources is typical of that found in other more inaccessible tissues of the body, such as muscle tissue.

Scientists who have previously tried to isolate and characterize the collagen from intramuscular connective tissue have based their efforts on extraction methods designed to remove interfering muscle proteins. But some of the substances used—urea, sodium acetate, and dilute sodium hydroxide—are known to also extract some of the collagen components, thus modifying the protein so it no longer has its original properties.

McClain's method of separating the connective tissue is based on selective fragmentation of muscle tissues at low temperature, using fresh muscle samples which have been freed of adhering fat and connective tissue and frozen at −70° C. All subsequent blending and sieving operations are carried out in −20° C. freezer. Final blending results in a white fibrous connective tissue mass almost completely devoid of adhering muscle tissue.

The ARS scientist is now investigating the subunit composition and cross-linking characteristics of the isolated collagen fibers as they relate to diet and to the aging process. Cross-linking refers to the bonds formed between chains of collagenous protein.

Results of preliminary studies indicate that cross-linking and certain other characteristics associated with collagenous tissues vary from muscle to muscle and may be related to muscular activity or exercise. ■

Cutting Costs in Witchweed Control

An odometer for spray rigs that works only when the sprayer is being operated promises to be a real money-saver.

The device was designed principally by W. A. Hayes, an agriculturist with the ARS witchweed laboratory, Whiteville, N.C., for use in the ARS-State witchweed control program.

Witchweed, a parasite of corn, sorghum, and other members of the grass family, is curbed by multiple applications of 2,4-D applied by private contractors who bid for the work on a per-acre basis. Therefore, the acres sprayed by each of a contractor's machines must be measured.

Up to now, fields were measured in a separate operation before treatment. The new odometer, however, measures the area covered by a sprayer during the actual spraying operation. Tested last summer, it proved at least as accurate as present measuring systems. And since it eliminates pretreatment measurement, it frees ARS personnel to supervise operations and carry out survey and regulatory functions.

The device works by electrically counting the number of revolutions made by a sprayer's nonpowered wheel. Multiplying the circumference of a wheel by the width of the spray rig by the number of revolutions is the system commonly used in agriculture to determine the acres covered by a machine.

To adapt this system to the witchweed program, a pressure-activated switch was added that restricts the recording of revolutions to the time when herbicide is being properly applied.

Witchweed in corn (N–33920).

Disease Tied to Sorghum, Sudan

Horses grazing on sudan and sorghum pastures have developed symptoms of a lathyrogenic (nervous) disease, reports ARS pathologist K. R. Van Kampen, Logan, Utah.

No previous relationship had been established between lathyrism and sudan and sorghum grass poisoning, but the similarities between the clinical nature of the two diseases suggests that a relationship may exist.

Affected animals lack muscular coordination of the hind legs, cannot control the discharge of urine, and have inflamed bladders. The offspring born to mares that have grazed sudan and sorghum pastures during pregnancy may be deformed.

Sudan and sorghum poisoning usually results when livestock have eaten plants in a stage of rapid growth after drought or freezing conditions which increased the level of hydrocyanic acid in the plants.

Enzymes that convert amino acids and hydrocyanic acid to lathyrogenic precursors have been isolated from sorghum plants. Though lathyrism has been recognized since the time of Hippocrates, it has not previously been reported as occurring naturally in this country.

Vacuum Wheel Meters Seed

A vacuum seed-metering wheel incorporated into a field planter may be a means to bigger yields in cotton, corn, and other crops.

The wheel, designed for single-seed placement, will make it possible to study precision planting patterns for crops planted in any row width. Proper adjustment of spacing between rows and between single plants within the row, produces the maximum growing area for each plant.

Uniform spacing of single seeds requires seed of the highest quality, germination, and vigor and a planter capable of consistently placing seeds in a good soil environment.

In Texas tests, ARS agricultural engineers E. B. Hudspeth, Jr., and D. F. Wanjura compared metering of delinted cotton seed by the vacuum wheel and by the conventional grain drill double-run wheel, both on bed-planted cotton in 40-inch rows.

The tests showed that 88 percent of the seeds planted by the vacuum wheel emerged while only 64 percent emerged in the double-run wheel rows.

Yields of lint in the vacuum wheel

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rows was 361 pounds while the double-run wheel rows yielded 341 pounds. Some of the difference in yield can be attributed to the more uniform spacing of plants by seed placement with the vacuum wheel.

The Texas Agricultural Experiment Station, Lubbock, is cooperating.

Nitrogen On Wheat

Yields of winter wheat increased threefold at Bozeman, Mont., by top-dressing with 120 pounds of nitrogen per acre just before seeding.

ARS soil scientist P. L. Brown studied six nitrogen rates (0, 60, 120, 180, 240, and 300 pounds per acre) on deep silty clay loam soil. The largest yield—71 bushels per acre—was dressing with 120 pounds of nitrogen rate, but 100 percent lodging occurred when more than 120 pounds of nitrogen was applied. The 120-pound rate produced 59 bushels per acre. Check plots yielded 19 bushels. Nitrogen fertilizer increased the number of wheat heads as much as 89 percent and the kernels per head as much as 145 percent. Kernel weights changed little.

The amount of water used by plants also increased by 9.2 to 13.0 inches. An additional 13 bushels of wheat was produced per inch of extra water—a high water-use efficiency.

Throughout the season, fertilized wheat used more water from each soil layer and from deeper soil layers than nonfertilized wheat.

During the study, the growing season in the Bozeman area was excellent for winter wheat. Some 8.5 inches of water was available to the 7-foot depth. Rainfall from May 15 to harvest was 6.5 inches. Spring wheat under almost identical conditions used nearly as much water to produce about half as much grain. The Montana Agricultural Experiment Station cooperated.

FCI–27

Three Tough Predators

Three insect predators are much less susceptible than aphids to two common insecticides—giving encouragement for the prospects of combining biological and conventional pest killers, a concept that entomologists call integrated control.

Integrated control may employ insecticides to knock down infestations to a low level, whereupon predatory insects mass-reared in the laboratory may be released to finish up the job. Smaller amounts of insecticide and fewer repeated applications would be needed according to theory. However, much more testing is needed.

Entomologists E. W. Hamilton and R. W. Kieckhefer conducted tests at Brookings, S. Dak., with three of the most widespread predators of English grain aphids—lady beetles, *Hippodamia convergens*, damsel bugs, *Nabis americoferus*, and green lacewings (aphid lions), *Chrysopa carnea*. The aphids are pests of corn, other cereals and alfalfa, among other crops.

The entomologists held the aphids and predators in containers coated with the same amount of insecticide usually found on crops. Surface concentrations were measured in parts per gram of insecticide per square centimeter. Both malathion and parathion gave similar results, killing aphids at much smaller doses than were needed to kill the predators.

This work was conducted in cooperation with the South Dakota Agricultural Experiment Station.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

PROTECT
Use Pesticides Safely
FOLLOW THE LABEL

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